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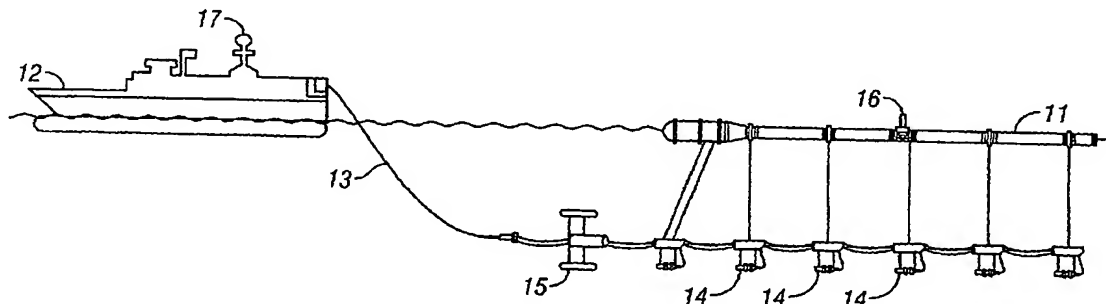
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **ACTIVE STEERING FOR MARINE SEISMIC SOURCES**



(57) Abstract: A seismic survey system having a source array (11) coupled to a deflector device (15) that controls the position of the source array. A positioning system unit (16) is mounted on the source array to provide a signal to a controller, informing the controller of the current position of the source array so that the controller can control the position of the deflector device (15) and the coupled source array. A seismic source (14) on the source array may be triggered when the source array is at a desired location or, alternatively, in a generally horizontal arrangement disposed adjacent to a central body (19). The streamlined central body has connection points that allow the deflector device (15) to be connected to a tow cable (13) from the tow vessel (12) and to the source array (11).

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2004/050527

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01V1/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|--|
| X | EP 0 018 053 A (SHELL INT RESEARCH) 29 October 1980 (1980-10-29) | 1-6,8, 12, 14-16, 18,19, 26, 32-37, 41, 43-45, 52, 58-60,62 |
| Y | abstract; figures 1-4,6 page 2, line 12 - line 18 page 10, line 27 - page 11, line 14 ----- -/-- | 7,9-11, 13, 38-40, 42,61 |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 October 2004

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2004/050527

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|--|
| Y | <p>WO 01/61380 A (SCHLUMBERGER CA LTD ; SCHLUMBERGER SERVICES PETROL (FR); LINDTJORN OLA) 23 August 2001 (2001-08-23)</p> <p>page 6, line 8 - line 9 page 7, line 22 - page 8, line 13 -----</p> | <p>7,9-11, 13, 38-40, 42,61</p> |
| X | <p>US 4 748 599 A (GJESTRUM EINAR ET AL) 31 May 1988 (1988-05-31) abstract; figures 1-4 column 2, line 8 - line 19 -----</p> | <p>1,4,26</p> |
| X | <p>US 4 323 989 A (HUCKABEE KERMIT D ET AL) 6 April 1982 (1982-04-06) abstract; figures 1-3,7 column 3, line 51 - line 54 column 5, line 13 - line 33 -----</p> | <p>1,2,4,26</p> |
| X | <p>EP 0 168 959 A (TEXAS INSTRUMENTS INC) 22 January 1986 (1986-01-22) abstract; figures 1,4,5 page 4, line 18 - line 23 -----</p> | <p>1,4-6</p> |
| X | <p>US 4 845 686 A (BRAC JEAN) 4 July 1989 (1989-07-04) abstract; figure 1 column 4, line 29 - line 38 -----</p> | <p>1,2,5,6</p> |
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2004/050527

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-16, 18, 19, 26, 32-45, 52, 58-60, 61b, 62

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-16,18,19,26,32-45,52,58-60,61b,62

This first group of claims solves the objective problem of improving positioning information applicable to a seismic survey system and method which comprises: a source array; an independently steerable deflector device to control the position of the array; and a positioning system comprising a positioning unit mounted on the array to determine the location of the source array with a controller operationally connected to control the position of the deflector, by means of the special technical feature, as defined by the subject-matter of dependent claim 7, being the use of GPS positioning, thereby enabling more accurate 4D surveying.

2. claims: 17,20-24,46-50,61a,64a

This second group of claims solves the objective problem of improving the usability of the deflector in a seismic survey system and method which comprises, a source array; an independently steerable deflector device to control the position of the array; and a positioning system comprising a positioning unit mounted on the array to determine the location of the source array with a controller operationally connected to control the position of the deflector, by means of the special technical feature being technical details on the construction of the deflector, thereby improving depth control and buoyancy characteristics as well as endurance.

3. claims: 27-31,53-57

This third group of claims solves the objective problem of preventing damage due to floating debris applicable to a seismic survey system and method which comprises: a source array; an independently steerable deflector device to control the position of the array; and a positioning system comprising a positioning unit mounted on the array to determine the location of the source array with a controller operationally connected to control the position of the deflector, by means of the special technical feature being a forward looking acoustical transducer and receiver to enable obstruction detection and avoidance.

4. claims: 25,51,63,64b-79

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This fourth group of claims solves the objective problem of improving efficient adjusting of relative positioning of a plurality of source arrays in a seismic survey system without the otherwise necessary re-trimming of the available deflectors by means of the special technical feature being a winch attached to distance ropes mounted between the respective source arrays, thereby enabling adjustment of relative distances.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP2004/050527

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
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